



Burrow occupancy and related behaviour of broad-billed prions *Pachyptila vittata vittata* on South East (Rangatira) Island, Chatham Islands, New Zealand

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**BURROW OCCUPANCY AND RELATED BEHAVIOUR
OF BROAD-BILLED PRIONS *PACYPTILA VITTATA VITTATA*
ON SOUTH EAST (RANGATIRA) ISLAND,
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ABSTRACT

Burrow competition is occurring between broad-billed prions (*Pachyptila vittata vittata*) and other small burrowing seabirds on South East (Rangatira) Island, Chatham Islands, New Zealand. This competition has a negative impact on the endangered Chatham petrel (*Pterodroma axillaris*) population. Seventy-seven broad-billed prion burrows were monitored nightly during the breeding season in 1996 and the non-breeding season in 1997 to determine burrow use patterns. From the total 246 broad-billed prions that were recorded in the non-breeding season 83% were returning breeders. Up to 10 broad-billed prions made use of individual burrows in the non-breeding season. Some movement of established breeding broad-billed prions between burrows in the non-breeding season occurred. Behavioural observations during the non-breeding season showed that broad-billed prions defended their burrow from others, spent time prospecting for burrows, pair bonded and attempted to establish ownership of burrows. Potential management strategies for broad-billed prions are discussed.

INTRODUCTION

Burrow competition with broad-billed prions (*Pachyptila vittata vittata*) is believed to be the major cause of decline in Chatham petrel (*Pterodroma axillaris*) numbers (West 1994). Broad-billed prions return to South East (Rangatira) Island to occupy burrows at the time Chatham petrels leave their young chicks unattended. Broad-billed prions oust Chatham petrel chicks from their burrows and use these burrows themselves. Consequently the survival of Chatham petrel chicks is dangerously low. Only a few species of petrels visit their breeding colonies outside the breeding season and the reasons for doing this are not understood (Warham 1990).

In this study we were investigating why broad-billed prions visit the breeding colony between breeding seasons, their activities and the importance of this in determining burrow occupancy.

Objectives for the project were as follows;

1. To study burrow prospecting behaviour and burrow use patterns of broad-billed prions in both the breeding and non-breeding seasons.
2. To establish whether broad-billed prions return to burrows used in a previous year or if they prospect for a vacant or Chatham petrel burrow in their non-breeding occupancy period.
3. To explore various methods of deterring broad-billed prions from using Chatham petrel burrows.
4. To determine how important non-breeding occupancy of burrows by broad-billed prions is in establishing ownership of burrows for the following years breeding.
5. To determine the importance of the non-breeding season occupation of South East Island to broad-billed prions.

Results for objective 2 are presented and discussed. Anecdotal impressions regarding objectives 1 and 5 are described and will be presented in detail in Nicolette's masters thesis. Objective 4 will be completed in November 1997 and will be presented in Nicolette's masters thesis. Objective three is discussed and field work will begin in November 1997. Field work for all five objectives will be continued in November 1997 and February - April 1998.

METHODS

Field work on South East Island took place from 06 February to 01 March 1996 (non-breeding season), 04 December to 18 December 1996 (breeding season) and 14 February to 14 April 1997 (non-breeding season).

Burrow occupancy

Seventy-seven broad-billed prion burrows were monitored nightly between 14 Feb. - 14 Apr. 1997 to determine burrow occupancy. Initially, occupancy was also monitored daily to ensure that the same prions were using burrows by day as were by night. The burrows were located in five areas; next to the hut, near Kokopu swamp, on the summit track, on the whalers bay track and in the remains of the old woolshed.

Every broad-billed prion found in a study burrow was banded and each time the burrows were checked the band number of any prion present was recorded. In the early stages of the Feb. to Apr. 1997 field season prions were head-marked to assist behavioural work. Head marking stopped when individually marking prions proved to be ineffective.

Study burrows were selected in February and December 1996. In February adult broad-billed prions found in 34 burrows were banded. Study burrows were restricted to those with a tunnel short enough that the hand of the field worker could touch the back of the chamber. This was necessary to enable the field worker to remove the prion for banding without altering the burrow. In December all burrows selected had a chick present. Sixty-four of these burrows were fitted with artificial nest chambers which consisted of a 16 litre plastic bucket fitted with a 105mm diameter novapipe tunnel.

Study burrow inspection protocols differed for the three different field seasons. In February 1996 burrows were inspected only during the last week of the field season and once two birds in any burrow had been banded that burrow was no longer inspected. In December 1996 both the burrows established in February 1996 and new burrows were inspected up to four times per night for the first seventeen days. In the five days of the December 1996 field season traps were constructed in the novapipe tunnel entrances and these were checked two times per night. In the February to April 1997 field season burrows were checked at least once per night.

Due to the large number of broad-billed prions on South East Island it was possible to choose easily accessible areas to use as study sites. In order to minimise the impact of field work on the island sites chosen were on frequently used tracks close to the hut. The one exception was the Kokopu Swamp site which was chosen because of the relatively high density of Chatham petrels in that area.

Non-breeding behaviour study

Behavioural observations took place at night when the broad-billed prions were ashore. By day they feed at sea. The behaviour study was split into three activities;

a) Ten minute spot counts of activity by all prions in sight.

This involved instantaneous recording of the activity of all visible broad-billed prions from a single location. The observer was stationary while recording activity, observations were taken at random sites. Originally counts were taken using the night vision equipment, however, experiments showed torchlight to be much more effective. Prions were visible up to a distance of fifteen metres depending on the density of foliage in the area. Spot counts were made at least once every twenty minutes throughout the nights field work.

These observations give an indication of the proportion of time broad-billed prions are involved in certain behaviours and the importance of each activity.

An initial observation period of eight nights established a range of behaviours that broad-billed prions use. These behaviours ranged from preening through to sleeping, interacting, courtship, prospecting and excavating.

b) Nightly prion count in the lower summit bush and recording of activity of all prions observed.

This involved two field workers walking one way along the lower summit bush track (approximately 400m) and recording the activity of prions on either side of the track. On some occasions a single field worker walked up the track and back recording prions to the left hand side of the track as they walked each way but this method was less accurate. The count took place at about 10.00 pm. Some nights an additional count was made at about 3.00 am when field workers were returning home through the lower summit bush. Torchlight was used and broad-billed prions were visible up to 15 metres. All prions within 15m of the track were recorded.

These observations give an indication of the numbers of prions present each night and their behaviours. Recording the behaviours gives a broader view of activities taking place as the summit count included much larger groups of prions than the spot counts. The summit counts allow us to explore the possibility that weather affects the number of prions on shore. They also allow us to compare the number of prions on the surface with prions in study burrows in an attempt to gain more in-depth understanding about the 'real' number of broad-billed prions on land on any given night.

c) Twenty minute studies of prion behaviour in an area, focusing on a single individual.

A broad-billed prion was chosen randomly and behaviours recorded continuously for twenty minutes. Random selection involved focusing on the first prion seen in the area. The length of time a prion was involved in each activity, the distance travelled within the 20 minute time slot, it's behaviours and any interactions with other prions were recorded. Prions were observed using a night vision scope and behaviour was recorded onto a hand held dictaphone. At the termination of each 20 minute period a spot count was made, the observer then either moved to a new area or continued observations at the same site on a different prion.

A 5 x 10 metre grid was set up in the lower summit bush. Grid squares were 1m x 1m. Study was concentrated in this area enabling more accurate estimates of distance travelled.

RESULTS

Objective one

1. To study burrow prospecting behaviour and burrow use patterns of broad-billed prions in both the breeding and non-breeding seasons.

Ten minute spot counts of activity and twenty minute studies of broad-billed prion activity resulted in the anecdotal impressions of prion behaviours as described below. Behavioural observations will be presented in detail in Nicolette's masters thesis.

- Breeding broad-billed prions do appear to defend their burrow entrance against other prions, driving them away by fighting and lunging at them.
- Many prions move through certain areas but not all of them are necessarily prospecting for burrows while doing so.
- Broad-billed prions that have established occupation of a burrow will still investigate other burrows in the near vicinity.
- Broad-billed prions who have established ownership of a burrow tend to stay within 5m of that burrow entrance while on the surface.
- Burrow prospecting involves prions either vocalising into or inspecting a burrow entrance. We have yet to determine if sound, smell or sight is important in burrow inspections.
- Broad-billed prions will spend up to 10 minutes inspecting the outside of the artificial burrow chamber when there is a prion in the burrow.
- During the non-breeding period broad-billed prions spent much time digging new burrows, renovating or extending existing burrows.

Objective two

2. To establish whether broad-billed prions return to burrows used in a previous year or if they prospect for a vacant or Chatham petrel burrow in their non-breeding occupancy period

Burrow occupancy was monitored in broad-billed prion study burrows each field season. The majority of broad-billed prions were never resighted in the burrow they were banded in or in any other study burrow. Of those broad-billed prions resighted between February and April 1997 approximately 20% were found in a burrow different from the one they were banded in. The results in Table 1 show little difference in the movement between burrows of the broad-billed prions first banded in the December 1996 breeding season and those banded in the February - April 1997 non-breeding season.

TABLE 1: Number of broad-billed prions only recovered in the same burrow they were banded in, the number recovered in different burrows to those banded in and the number never resighted.

Field seasons	Different burrow	Same burrow	Never resighted
Feb. 1996 - Dec. 1996	1	2	51
Feb. 1996 - Feb. 1997	9	20	25
Dec. 1996 - Feb. 1997	14	56	78
Feb. 1997 - Apr. 1997	15	56	74

Up to 7 unbanded broad-billed prions were recorded using the study burrows in the February to April 1997 field season (Table 2). The majority of these prions were never resighted, however a proportion of them established ownership of study burrows.

TABLE 2: Number of unbanded broad-billed prions found in broad-billed prion study burrows in the Feb. - Apr. 1997 field season.

		Number of burrows with 1 - 7 unbanded birds						
No. of birds in burrows		1	2	3	4	5	6	7
No. of burrows		21	20	8	4	4	2	1

Most of the study burrows were used by between 2 - 4 broad-billed prions, however, one burrow had 10 birds found in it (Table 3). The total number of broad billed prions in Table 3 represents both broad-billed prions known to have previously bred in study burrows and those not previously recorded associating with the burrows.

TABLE 3: Total number of broad-billed prions associated with study burrows in the Feb. Apr. 1997 field season.

		Number of burrows with 1 - 10 birds recovered									
No. of birds in burrows		1	2	3	4	5	6	7	8	9	10
No. of burrows		5	14	12	17	9	1	3	6	2	1

Prior to February 1997, 201 broad-billed prions had been banded in the seventy seven study burrows. In December 1996, 81 breeding and 64 fledgling broad-billed prions were banded in study burrows. In the February to April non-breeding season 67 (83%) of these breeding birds were recaptured in the study burrows

A total of 246 broad-billed prions were recorded using the study burrows between 14 February and 14 April 1997. During this period 137 previously unbanded birds were recorded in these burrows. The remaining 109 individuals had used the study burrows previously.

Sixty nine of the seventy-seven study burrows (90%) were used by broad-billed prions during the February-April 1997 field season.

Objective three

3. To explore various methods of deterring prions from using Chatham petrel burrows.

Four potential deterrents have been suggested.

1) Aural

A suggested management technique is to make recordings of broad-billed prion vocalisations. These vocalisations would be played back in broad-billed prion burrows to test the possibility of deterring prions from using burrows / areas. Tests would involve connecting vocalisations with their corresponding behaviours.

To be tested in February 1998.

2) Olfactory

A variety of scents will be tested to be used as possible attractants or deterrents. Research will take place prior to the December 1997 field season to determine potential scents to be used.

On 05 March 1997 a test took place where we applied cod-liver oil to a patch of exposed tree root to see if it would attract broad-billed prions. Broad-billed prions were unresponsive to the oil.

Further testing will take place February - April 1998.

3) Feeding barrier

A netting feeding barrier has been proposed that will prevent broad-billed prions from injuring Chatham petrel chicks but will allow the chicks to be fed by their parents. The proposed barrier would be inserted into artificial Chatham petrel burrows allowing enough room for an adult to manoeuvre on one side of the barrier. Details of the net material to be used to construct the barrier are yet to be decided. Before being used in a Chatham petrel burrow the barriers will be tested in a small sample of broad-billed prion burrows. On two occasions in the December 1996 field season adult broad-billed prions were observed feeding their chicks through malfunctioning mesh trap doors. These chicks were close to fledging and consequently very mobile. These observations lead us to believe that feeding barriers may be successful management tools. Testing will focus on determining at what age chicks are mobile enough to be able to approach their parent for food. It is expected that the stages of development of broad-billed prion and Chatham petrel chicks take approximately the same length of time and that the information compiled about the prions will be able to be used as a guideline for the petrels.

To be tested in November / December 1997.

4) Blockading

Nineteen broad-billed prion study burrows were blockaded in May 1997, using the same blockades at the same time as Chatham petrel burrows were blockaded. This testing will show whether or not broad-billed prions who have ownership of these burrows will return if they are prevented from breeding there for a season. Burrows selected are located close to other study burrows in the hope that if there is local movement between burrows by the prions they will use other study burrows. Only burrows in the Lower Woolshed Bush study sites were blockaded. The Kokopu Swamp site was not used for testing as there is potential for an increase in competition for burrow space and this may have a negative impact on the Chatham petrels in the vicinity.

Objective four

4. To determine how important non-breeding occupancy of burrows is in establishing ownership of burrows for the following years breeding.

This will be determined in November 1997 when we record the band numbers of birds breeding in the study burrows to see if previous breeders or non-breeders that visited the burrows in the winter, breed in the next year.

Objective five

5. To determine the importance of the non-breeding season occupation of the island to prions.

Non-breeding occupation of the breeding colonies may be important to broad-billed prions for;

1. Pair bonding
2. Burrow defence
3. Burrow prospecting
4. Establishing ownership of burrows

The data collected so far, in addition to that to be collected in Nov. 1997 and Feb. - Apr. 1998 will allow these questions to be tested. The results of this will be discussed in Nicolette's thesis.

DISCUSSION

Burrow competition between broad-billed prions and Chatham petrels is complex. The nature of the problem stems from the fact that broad-billed prions are a very successful native species whose limiting resource appears to be burrows. Broad-billed prions breed earlier than the other species nesting on South East Island and they occupy the island in their non-breeding season (West 1994).

Results show us that most breeding broad-billed prions return to their burrows in the non-breeding season. In addition to these established breeders, up to eight other birds have been recorded visiting burrows that were occupied by breeding birds (Table 3). This multiple occupancy suggests significant pressure on available burrows and that burrows are a significant limiting resource for the broad-billed prions of South East Island. Broad-billed prions attempt to dig new burrows and take over existing burrows, whether these be Chatham petrel, broad-billed prion or even burrows rightfully occupied by other species. The island itself can not cope with this amount of excavation and the soil is friable and honeycombed. Little suitable ground remains for the excavation of new burrows.

Chatham petrels are only one species that are affected by the broad-billed prions. Broad-billed prions are also ousting white-faced storm petrels (*Pelagodroma marina maoriana*), common diving petrels (*Pelacanoides u. urinatrix*) and other broad-billed prions from established burrows.

Observations suggest that breeders with ownership of burrows who return to the island will oust non-breeders who have returned earlier from their moult and taken possession of their burrow. An example of this took place on 23 February 1997 when a pair of broad-billed prions were observed in the tunnel entrance of the burrow they had bred in the previous year vocalising with a broad-billed prion that was in the burrow chamber. The prion in the burrow chamber had been banded in the burrow six days previous and was returning to the burrow for the third time. The broad-billed prions in the tunnel entrance were both breeding birds that were returning for the first time recorded in the non-breeding season. All three birds left the burrow after handling. The recently banded birds never returned to the burrow, the two breeding birds returned once or twice more and then also never returned.

At the completion of the Feb. - Apr. 1997 field season unbanded birds were still being captured in the study burrows and some breeding birds had only recently been first recorded on the island since the breeding season. Further burrow counts took place in May 1997, the results from these counts will give valuable information regarding this issue.

We suggest there are three possible burrow use scenarios with corresponding management implications.

1. **Breeding burrows are only being used by breeding adults.** This scenario would suggest a stable population. If this scenario was correct management could involve removing broad-billed prions from burrows surrounding known Chatham petrel burrows. We could expect a reduction in broad-billed prion density in the areas culling took place.
2. **Broad-billed prions do not establish ownership of burrows and will return to any burrow available.** This is an undesirable scenario. There would be no stability in the population. The removal of broad-billed prions will achieve little, if anything, as it is likely that as soon as a prion is culled in a burrow a new one will replace it.

3. Breeding adults will return to their established breeding burrows and non-breeding birds will also prospect and attempt to establish themselves in these burrows. This scenario would also be undesirable. Management could involve culling the breeding adults and then culling the other prions visiting the burrows. It is possible that removing the stable part of the population and creating the same vacuum described in scenario two will potentially create a worse problem than the one at present.

Information to date suggests that on South East Island we have scenario three. Established breeding prions are returning to their burrows and non-breeding birds are prospecting and also attempting to establish themselves in these burrows. With the intense competition for burrows, the culling of broad-billed prions in the vicinity will just create a low density area which will take but days to fill. Consequently management by culling broad-billed prions in burrows surrounding Chatham petrel burrows will achieve little if anything. Removing broad-billed prions from Chatham petrel burrows that are being used for breeding by the petrels will help the Chatham petrel population in the short term by; a) giving chicks the opportunity to fledge, and b) allowing maximum opportunity for Chatham petrels to return to burrows they have previously established themselves in.

Burrow competition between the two species is intense and is adversely affecting the Chatham petrels. Up to now management has involved blockading Chatham petrel burrows at the end of the Chatham petrel breeding season. This allows Chatham petrels to begin breeding but studies by Philippa Gardner (pers. comm) suggest it has little affect at preventing later interference by broad-billed prions. Our results show why with up to eight non-breeding as well as breeding broad-billed prions using burrows. Blockading only deters breeding prions. Our observations suggest that culling broad-billed prions in Chatham petrel burrows may reduce pressure from broad-billed prions on Chatham petrels but with many other prions seeking burrows it will only give night by night relief.

CONCLUSION

For the benefit of all small burrowing petrels we need to reduce the density of broad-billed prions on South East Island. Culling is not a justifiable option as there are too many broad-billed prions involved and the population is mobile and actively seeking burrows. Attracting pre-breeding broad-billed prions to Pitt island is an option to be investigated as a potential future management strategy. In the short term Chatham petrels are in a precarious situation. It is necessary to manage the Chatham petrel population in order to allow numbers to increase to a level that may allow the possibility of translocation or other future management possibilities.

We recommend the following **short term** management techniques;

1. Continue blockading Chatham petrel burrows after their breeding season to prevent broad-billed prions from establishing a bond with these burrows.
2. Testing and if viable using the feeding barrier suggested to prevent injury of Chatham petrel chicks by broad-billed prions prior to fledging.
3. Culling broad-billed prions that are entering Chatham petrel burrows until the feeding barriers are established.

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